Geoscience Canada

Jurassic Magmatism and Tectonics of the North American Cordillera

Bob Anderson

Volume 25, Number 2, June 1998

URI: https://id.erudit.org/iderudit/geocan25_2br03

See table of contents

Publisher(s)

The Geological Association of Canada

ISSN

0315-0941 (print)
1911-4850 (digital)

Explore this journal

Cite this review

Anderson, B. (1998). Review of [Jurassic Magmatism and Tectonics of the North American Cordillera]. *Geoscience Canada*, *25*(2), 94–95.

tural overlap make some orangeites difficult to distinguish from group I kimberlites and lamproites. Chapter 2, the main focus of the volume, provides a complete and extensive synthesis of the primary mineralogy of orangeites, with detailed comparisons to group I kimberlites and lamproites. Chapter 3 features the geochemistry of orangeites, again with comparisons to group I kimberlites and lamproites, and summarizes radiogenic and stable isotope data. Orangeites have closer affinities to lamproites than kimberlites, as a consequence of their derivation from similar metasomatically enriched lithospheric mantle sources. Both are derived from ancient sources located in nonconvecting lithospheric mantle.

The final chapter provides detailed consideration of the petrogenesis of orangeites and kimberlites, beginning with a review of earlier hypotheses and progressing to new models. Mitchell states that orangeites do not occur outside the Kaapvaal craton, although he recognizes that they belong broadly to a family of magmas linked to metasomatic effects in the lithospheric mantle. He does not synthesize information from upper mantle xenoliths or xenocrysts, an omission that must be addressed to understand more clearly the processes involved in generation of diamond-bearing rocks beneath the Kaapvaal craton; in particular, the spatial and temporal evolution of source regions in the mantle. All dated orangeites are older than about 110 Ma, whereas most group I kimberlites were emplaced between 85-100 Ma (Gurney and Menzies, 1998). It seems that the composition and thermal structure of the Kaapvaal lithosphere was modified at about 90 Ma, a change associated with regional uplift and denudation of the craton prior to eruption of many group I kimberlites. Did this event eliminate the enriched source region for orangeites?

The paucity of data from most kimberlite provinces other than South Africa makes detailed consideration of Mitchell's regional hypothesis for the unique character of orangeites virtually impossible. Perhaps it is premature and somewhat extreme to imply that orangeites will not be found in other cratons. Why should specific processes form group I kimberlites and orangeites beneath southern Africa, but not occur beneath other cratons? With the exception of the xenolith data, Mitchell has brilliantly ordered and effectively presented a wide range of new information on kimberlites and orangeites to stand as an important sourcebook beside his previous volumes. New advances in synthesis and understanding of the source regions for diamond-bearing rocks will arise from studies heralded by this work.

REFERENCES

Ayres, N.P., Hatton, C.J., Quadling, K.E. and C.B. Smith, C.B., 1998, Update on the distribution in time and space of southern African kimberlites: 1: 5 million scale maps, 7th International Kimberlite Conference, University of Cape Town.

Gurney, J. and Menzies, A. 1998, Small mines field excursion: 7th International Kimberlite Conference, University of Cape Town, 40 p.

Jurassic Magmatism and Tectonics of the North American Cordillera

Edited by David M. Miller and Cathy Busby
Geological Society of America
Special Paper 299
1995, 432 p., US$95.00, paperback

Reviewed by Bob Anderson
Geological Survey of Canada
GSC Pacific
101-605 Robson Street
Vancouver, British Columbia V6B 5J3

In the Canadian Cordillera, Jurassic magmatism was an important part of the accretionary history and mountain-building consequence of terrane assembly; as well, Jurassic volcanic and plutonic rocks are disproportionately enriched in base and precious metals compared with any other Phanerozoic arc system. To the south, Jurassic magmatism marked the precursor to later events that so strongly shaped the present geology of the western United States.

Consequently, any volume that promises an orogen-wide integration of Jurassic magmatism and tectonics is awaited with some anticipation. A theme session at the 1991 San Diego Geological Society of America (GSA) Annual Meeting and a subsequent 1994 GSA Penrose Conference on Jurassic Magmatism and Tectonics of the North America Cordillera organized by Dave Miller, Cathy Busby and others underlie this volume. A compendium of 19 papers, derived in part from contributions to these meetings, is brought together by Miller and Busby in GSA Special Paper 299. It is an important milestone in the description and tectonic synthesis of Jurassic magmatic regimes and structural styles preserved in autochthonous and formerly allochthonous terranes extending from Yukon to southernmost United States along the present margin of the North American plate. In the course of 192 figures, 50 tables, and almost 2000 references encompassed within the 19 papers, the volume succeeds in providing a significant overview geographically, temporally and conceptually of Jurassic geological history along North America's western margin. In addition to the preface, a frontispiece photograph of R.L. (Dick) Armstrong and a subject index at the back round out the contents; the table of contents is helpfully reproduced on the back cover of the book.

Special Paper 299 serves a secondary, although no less important purpose as a memorial to the late Dick Armstrong (University of British Columbia), whose data, syntheses and ideas implicitly or explicitly form points of departure for many of the new contributions. One is continually reminded of his integrative style of tectonic synthesis, a theme present throughout the volume.

In their preface, editors Miller and Busby see the volume as providing a multidisciplinary view of mainly Jurassic (but also including Triassic and Cretaceous) volcanism, plutonism, metamorphism, structural development, geochemical and isotopic evolution, metallogeny, and sedimentology of Jurassic tectono-magmatic events. New structural and stratigraphic field data and syntheses obviously predominate in this volume, and are shown to be critical to understanding processes as diverse as terrane assembly and the inter-relationships between deformation style(s) and magmatism (exemplified in papers by Murphy *et al.*, Elison, Wadsworth *et al.*, and Miller and Hoisch). The value of unraveling the stratigraphic and sedimentological record of magmatism

proximal (Hart *et al.*) and distal to the arc (Blakey and Parnell) is well demonstrated. The importance of precise, mainly U-Pb, geochronology in dating and correlating events is emphasized in publication of new U-Pb and K-Ar dates in 11 of the 19 contributions: the large compendium of new ages for the southern Coast Mountains by Friedman and Armstrong is a landmark contribution. New geochemical data are found in six papers; radiogenic isotopic tracer data in three papers, of which the Ghosh and St. J. Lambert paper is outstanding. Gerber *et al.* provide the best example of the integration of comprehensive and diverse geochronological, geochemical and isotopic data sets. Inclusion of some discussion of mineral deposit formation (papers by Ward, and Presnall and Parry), is welcome, because metallogeny is rarely considered by tectonicists yet is an undeniable and economically important crustal process in the Jurassic. Discipline-oriented lists summarize the wide-ranging content of the volume, but are somewhat misleading here because most papers integrate several types of data to arrive at their conclusions (papers by Wolf and Saleeby, Elison, and Miller and Hoisch are exemplary in this regard).

The volume opens with a lengthy, provocative view of Mesozoic and Cenozoic subduction cycles involving the western North American margin by Ward. Following Ward's "tour-de-tectonics," the volume's more topical contents are organized in three groups, from north to south, and approximately oldest to youngest: Canadian Cordillera (Yukon and British Columbia: six papers); Klamath Mountains, Sierra Nevada and Great Basin (eight papers); and southwestern United States desert regions and Colorado Plateau (four papers). Within each group, papers are organized in sequence from magmatic arc eastward.

The consistent layout and format of the papers in the volume are up to the GSA's usual high standard of excellence. Authors might have more carefully considered or have been coached by the editors on the final layout specifications when choosing line widths and patterning for their maps and sections: some figures are reduced to near illegibility.

As is the case with most proceedings-style volumes, this compendium of generally excellent papers would benefit from a final synthesis paper — a kind of "epilogue" to update Ward's process-focused introduction — which would tie together the disparate contributions into a Cordillera-wide whole. At the least, such a summary would alert the Jurassic newcomer to the areal significance of an individual paper's contribution. The editors' rebuttal might be that the only contributor capable of such a broad understanding of the entire Cordilleran Jurassic tectono-magmatic event is, sadly, the person to whom the Special Paper is a memorial. For the non-aficionado, a generalized distribution map of Jurassic rocks annotated with the study area locations would have been a valuable addition to the preface and/or the table of contents. Similarly, an author index, to accommodate collaborative papers containing as many as nine authors, would have been a worthwhile companion to the detailed subject index included at the back of the volume.

This volume provides an important three-dimensional look into the components of a now-eroded, subduction-driven Cordilleran orogeny. GSA Special Paper 299 provides a handy repository of new data, ideas and critical literature references for this geologically interesting and diverse period, and is a monument to the efficacy of a multidisciplinary approach in deriving new first-order syntheses and models. Only the somewhat steep price tag for the volume will impede its appearance on the bookshelves of researchers interested in either the wide variations in tectonic and magmatic regimes evident in a well-studied tectono-magmatic belt, or in the overall evolution of Jurassic rocks along the North American continental margin. Merchandizing niggles aside, the special paper succeeds in bringing together the former twin solitudes of Jurassic tectonics research north and south of the 49th parallel, to their mutual benefit.

Middle Proterozoic to Cambrian Rifting, Central North America

Edited by Richard W. Ojakangas, Albert B. Dickas and John C. Green
Geological Society of America
Special Paper 312
1997, 328 p., US$100.00, paperback

Reviewed by G.M. Ross
Geological Survey of Canada
3303 33 Street NW
Calgary, Alberta T2L 2A7

This special paper is a collection of 18 papers that describes various elements of the Midcontinent Rift System (MRS) and also examines postulated extensional basins of Eocambrian age within the midcontinent of North America, the United States in particular. The MRS is one of the world's most spectacular and well-studied ancient rift basins, even though it is buried throughout much of its length and generally not well exposed. It is characterized by distinctive potential field signatures that allow it to be traced for a strike length of nearly 2000 km, comparable in length to the modern East African Rift system. Recent high-precision U-Pb geochronology indicates a short duration for the formation of the remarkable magmatic products that fill this structure (*ca.* 20 m.y.), and recent crustal seismic reflection data (the GLIMPCE survey) illuminate the geometry and dramatic consequences of crustal rifting that for some reason did not proceed to open ocean.

The compendium of papers begins with an integrated overview of the MRS by W.J. Hinze and others, which is an excellent regional framework paper and includes a comparison with the East African Rift system. Importantly, these authors offer unanswered questions and outstanding remaining problems for future research. This paper sets the stage for the subsequent paper by A.B. Dickas that amplifies the comparison with African rift systems and describes the segmented nature of the MRS. The subsequent paper by D.J. Allen and others uses a grid of seismic reflection lines and potential field modeling to offer details of the geometry of fill within the MRS in the western Lake Superior re-